

22. (New) The system of claim 16, wherein the second focal axis and the third focal axis are the same.

Amendments to the Drawings

The attached sheet of drawings includes changes to Figures 1-18. The sheet that includes Figure 1 now replaces the original sheet that included Figure 1. In Figure 1, the lines connecting and identifying certain representational components have been repositioned for reasons of clarity. In Figure 1, the shape of the boxes have been changed and repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted some of the words in Figure 1, without prejudice and for reasons of clarity. No new matter has been added to Figure 1. Additionally, the arrow pointing to the block previously labeled “main computer console” has been deleted. Accordingly, Applicant respectfully requests the withdrawal of the objection to Figure 1.

In this application, Applicant has added new Figure 1A. Support for new Figure 1A is in the portion to the right of the squiggly-drawn-in line in annotated Figure 1. No new matter has been added to the specification as originally filed by including new Figure 1A.

In this application, Applicant has added new Figure 1B. Support for new Figure 1B is in the portion to the left of the squiggly-drawn-in line in annotated Figure 1. No new matter has been added to the specification as originally filed by including new Figure 1B.

The sheets that includes Figure 2 now replaces the original sheet that included Figure 2. In Figure 2, the lines connecting and identifying certain representational components have been repositioned for reasons of clarity. No new matter has been added to Figure 2.

The sheets that includes Figures 3 and 4 now replaces the original sheet that included Figure 3 and the original sheet that included Figure 4. In Figures 3 and 4, the lines connecting

and identifying certain representational components have been repositioned for reasons of clarity. No new matter has been added to Figures 3 and 4.

The sheet that includes Figure 5 now replaces the original sheet that included Figure 5. In Figure 5, the lines identifying certain representational components have been repositioned for reasons of clarity. In Figure 5, element 513 has been added. Support for the addition of element 513 is found in paragraph 0051 of the specification as originally filed. Additionally, Applicant has deleted the words in Figure 5, without prejudice and for reasons of clarity. No new matter has been added to Figure 5.

The sheets that includes Figures 6 and 7 now replaces the original sheet that included Figure 6 and the original sheet that included Figure 7. In Figures 6 and 7, the lines identifying certain representational components have been repositioned for reasons of clarity. No new matter has been added to Figures 6 and 7.

The sheet that includes Figure 8 now replaces the original sheet that included Figure 8. In Figure 8, the lines identifying certain representational components have been repositioned for reasons of clarity. No new matter has been added to Figure 8.

The sheet that includes Figure 9 now replaces the original sheet that included Figure 9. In Figure 9, Applicant has deleted the title, without prejudice and for reasons of clarity. No new matter has been added to Figure 9.

The sheet that includes Figure 10 now replaces the original sheet that included Figure 10. In Figure 10, the lines connecting and identifying certain representational components have been repositioned for reasons of clarity. In Figure 10, the shape of the boxes have been changed and repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted

some of the words in Figure 10, without prejudice and for reasons of clarity. No new matter has been added to Figure 10.

The sheet that includes Figures 11, 12, and 13 now replaces the original sheet that included Figures 11 and 12, and that portion of the sheet that included Figure 13. In Figures 11, 12, and 13 the lines identifying certain representational components have been repositioned for reasons of clarity. In Figures 11, 12, and 13, the boxes have been repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted some of the words in Figures 11, 12, and 13 without prejudice and for reasons of clarity. No new matter has been added to Figures 11, 12 and 13.

The sheet that includes Figures 14, and 15 now replaces the original sheet that included the portion of the sheet that included Figure 14 and the portion of the sheet that included Figure 15. In Figures 14 and 15 the lines identifying certain representational components have been repositioned for reasons of clarity. In Figures 14 and 15, the shape of the boxes have been changed and repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted some of the words in Figures 14 and 15 without prejudice and for reasons of clarity. No new matter has been added to Figures 14 and 15.

The sheet that includes Figures 16 and 17 now replaces the original sheet that included the portion of the sheet that included Figures 16 and 17. In Figures 16 and 17 the lines identifying certain representational components have been repositioned for reasons of clarity. In Figures 16 and 17, the shape of the boxes have been changed and repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted some of the words in Figures 16 and 17 without prejudice and for reasons of clarity. No new matter has been added to Figures 16 and 17.

The sheet that includes Figure 18 now replaces the original sheet that included Figure 18. In Figure 18, the lines connecting and identifying certain representational components have been repositioned for reasons of clarity. In Figure 18, the shape of the boxes have been changed and repositioned for reasons of clarity and stylistic preference. Additionally, Applicant has deleted some of the words in Figure 18, without prejudice and for reasons of clarity. No new matter has been added to Figure 18.

Accordingly, Applicant respectfully requests withdrawal of the objection to the drawings filed on September 18, 2003.

Remarks

Applicant has cooperated with the Office Action's request that the lengthy specification be checked to determine the presence of possible minor errors. Accordingly, Applicant has amended paragraph numbers 14, 16, 20, and 23 merely for grammatically stylistic reasons, without prejudice. Paragraph 11 has been amended to accommodate new Figure 1A and new Figure 1B. The new figures are supported by Figure 1 as originally filed, no new matter has been added. Paragraph 13 has also been amended to accommodate new Figure 1A and new Figure 1B. The amendments to Paragraph 13 are supported by Figure 1 as originally filed, no new matter has been added. Paragraph 34 has been amended to correct the unintentional mistake of referring to Figure 2, when clearly referring to Figure 4. Support for the amendment is found in Figure 4 as originally filed. Additionally, Applicant has amended paragraph 69 to further explain Figure 9. Support for this amendment can be found in the title to Figure 9 as originally filed. Applicant respectfully asserts that no new matter has been added in these amendments to the specification.

In this application, Applicant has respectfully developed a novel system for rendering high-resolution, high accuracy, low distortion digital images over very large fields of view. In particular, independent Claim 1 is directed toward a system for generating a map of a surface, comprising: a global position transmitter; a vehicle, disposed over the surface; an elevation measurement unit, secured to the vehicle; a global positioning antenna, secured to the vehicle; an attitude measurement unit, secured to the vehicle; an imaging array, secured to the vehicle, comprising: a housing; an aperture, disposed in the housing, having an intersection area therein; a first imaging sensor, coupled to the housing, having a first focal axis passing through the aperture within the intersection area; and a second imaging sensor, coupled to the housing and

offset from the first imaging sensor, having a second focal axis passing through the aperture and intersecting the first focal axis within the intersection area; a computer, connected to the elevation measurement unit, the global positioning antenna, the attitude measurement unit and first and second imaging sensors; correlating at least a portion of the image data from the first and second imaging sensors to a portion of the surface based on input from one or more of: the elevation measurement unit, the global positioning antenna and the attitude measurement unit.

Claims 1-22 are currently pending in this application, wherein Claim 4 is object to; Claims 2-4, 6, 7, and 15-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite; Claims 1-20 are rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. 5,878,356 (“Garrot”) in view of U.S. 2002/0060784 (“Pack”) and U.S. 4,689,748 (“Hoffmann”); and Claims 21-22 are newly presented.

Informal Objection

Claim 4 has been amended to delete the extraneous “wherein 2” as requested in the Office Action. Applicant has added no new matter in correcting this minor informality. Accordingly, Applicant respectfully requests the objection to Claim 4 be withdrawn.

35 U.S.C. 112, second paragraph

Claim 2 has been amended to make clear that the third imaging sensor has a third focal axis passing through the aperture, which is in one embodiment different from the second focal axis. Applicant, however, has added Claim 21 to makes clear that in an alternative embodiment the second focal axis and the third focal axis can be the same. Support for the newly added

Claim 21 can be found in paragraph 0027, lines 7-10 of the specification. Support for the amendment to Claim 2 can be found in paragraph 8, lines 12-15 of the specification. No new matter has been added to Claims 2 or 21. Accordingly, Applicant respectfully requests the withdrawal of this rejection.

The Office Action states that Claim 4 lacks antecedent basis in the recitation of “the first common plane.” Respectfully, however, Applicant asserts that Claim 4 as filed correctly recited “a first common plane” in line 2 of Claim 4, and then correctly recited “the first common plane” in line 3 of Claim 4. Applicant kindly requests that the Examiner contact the undersigned attorney via telephone at 713.276.5382 in the event the Examiner believes that Claim 4 as originally filed incorrectly recited “the first common plane.” Accordingly, Applicant respectfully requests the withdrawal of this rejection.

Claim 6 has been amended to correct the antecedent basis—as requested in the Office Action—and make clear that the first plane in line 2 of Claim 6 is the same plane as the first plane in line 4 of Claim 6. Applicant makes this amendment without prejudice to merely comply with the generally acceptable lexicon of patent prosecution. No new matter has been added to Claim 6. Accordingly, Applicant respectfully requests the withdrawal of this rejection.

Claim 15 has been amended to make clear that the array mentioned in line 18 of Claim 15 referred to the mosaic generated from the first array of pixels and the second array of pixels. Support for the amendment can be found in paragraph 0035 and Claim 1 as originally filed. No new matter has been added to Claim 15. Accordingly, Applicant respectfully requests the withdrawal of this rejection.

Claim 16 has been amended to make clear that the third imaging sensor has a third focal axis passing through the aperture, which is in one embodiment different from the second focal axis. Applicant, however, has added Claim 22 to make clear that in an alternative embodiment the second focal axis and the third focal axis can be the same. Support for the newly added Claim 22 can be found in paragraph 0027, lines 7-10 of the specification. Support for the amendment to Claim 16 can be found in paragraph 8, lines 12-15 of the specification. No new matter has been added to Claims 16 or 22. Accordingly, Applicant respectfully requests the withdrawal of this rejection.

Claims 3, 7, and 17-20 were rejected under 35 U.S.C. § 112, second paragraph as being dependent from a rejected base claim. In light of the above reasoning and amendments, Applicant respectfully requests the withdrawal of the rejection under 35 U.S.C. § 112 to Claims 3, 7, and 17-20.

35 U.S.C. § 103(a)

Applicant has amended independent Claim 1—and therefore its dependencies—to make clear that the first imaging sensor generates a first array of pixels and the second imaging sensor generates a second array of pixels. Support for the amendment is found in paragraph 0035 and in Claim 15 as originally filed.

Garrot is directed toward a system for generating thermal/infrared images of land that can be useful in agricultural applications. (Garrot Abs. and Col. 1, lines 12-14) In this manner, Garrot discloses an aircraft based imaging system for acquiring infrared signals and georeferencing the acquired signals. (Garrot, Abs.) The infrared imaging sensor disclosed in Garrot has a single lens and produces a multispectral-unidirectional line scan—in a manner

similar to a photocopier. As noted in the Office Action this technology is not comparable to the imaging array of Applicant's invention. Accordingly, the Office Action submits that it would have been obvious to one of ordinary skill to replace the sensor of Garrot with the device disclosed in Hoffman. Applicant respectfully asserts that this substitution is not obvious, and even if one were to use the device disclosed in Hoffman in place of the sensor disclosed in Garrot Applicant's claimed invention would be neither anticipated nor made obvious.

Hofmann discloses a device that consists of parallel rows of photosensitive semiconductor elements and a lens system. (Hoffman, Abs.) Hofmann characterizes its device as a 'stereo line scanner', and boasts that "it is now possible, in principle, to compute the relative orientation of this device or 'stereo line scanner' for each individual line scan period by causing the rays..." (Hoffman Col. 3, lines 39-46) Accordingly, Applicant's have amended their claims to more clearly define their imaging sensors. As amended, Applicant's claims require an imaging array, which comprises an imaging sensor that generates at least a first and second *array* of pixels—as opposed to a line scan. (emphasis added) A line scan sensor rapidly records successive images in rows of pixels—in a manner analogous to the way the light moves across a photocopier. In contrast to the line scan sensors disclosed in Garrot and Hofmann, Applicant's imaging sensors generate arrays of pixels. It was generally thought, prior to Applicant's disclosure that imaging sensors generating arrays would not produce high-resolution, high-accuracy, low-distortion digital images over very large fields of view. Moreover, Hofmann teaches that "if the scanning is done by an arrangement wherein each of the sensor lines has a different lens system assigned to it ... nothing will basically change as far as this computational method is concerned", and therefore teaches away from using sensors that generate arrays. (Hoffman Col. 4, lines 24-29) Accordingly, nothing in Garrot, or Hofmann teaches or suggests

using an imaging sensor, which generates at least a first and second array of pixels in combination with Applicant's claimed system.

Pack discloses a system for generating georectified three dimensional images and topography. (Pack, Abs.) In this manner, Pack discloses the use of a LIDAR system to collect elevation data of a surface. (Pack, paragraph 0058) Pack also discloses the use of a digital camera to collect "passive spectral radiation". (Pack, paragraph 0057) Applicant respectfully asserts that Pack is using a digital camera to generate a visual reference, which is used to better orient the elevation surface data. In contrast, Applicant uses a digital camera as an integral part of a complex system directed toward mapping digital images. Nothing in Pack fairly suggests using a digital camera in a complex system to map digital images. In fact, Pack teaches away from using a digital camera in a complex system.

Pack discloses a system of producing "georectified three dimensional digital imagery in real time", without the "complex analytic equations..." (Pack Abs: Col 1, paragraph 0007) Applicant therefore asserts that as Pack teaches away from complex analytic equations, it would be an exercise in impermissible hindsight reconstruction—as well as a gross simplification of the art—to suggest one of ordinary skill in the art would have been motivated to substitute the digital camera disclosed in Pack for the imager disclosed in Garrot. Moreover, Applicant submits that even if one were to have made such an unlikely substitution they would not be able to make a working system without the use of complex analytic equations. There is simply no motivation to substitute a camera used to visually reference the elevation data of a LIDAR system for a camera used to collect thermal/infrared images of land. Therefore, Applicant respectfully asserts there is a lack of motivation to combine Pack and Garrot.

Alternatively, assuming—*arguendo*—one of ordinary did combine Pack and Garrot they would not arrive at Applicant's claimed invention as described in Claims 1-7 and 13-20. Specifically, Pack fails to fairly teach or suggest the presence of a second imaging sensor.

Applicant submits that the claims are novel and not made obvious by Garrot, Hofmann, Pack or their combination. Accordingly, Applicant respectfully requests withdrawal of the rejection under 35 U.S.C. § 103(a) to Claims 1-20.

Finally, Applicant respectfully informs the Examiner that the subject matter of each claim was commonly owned at the time of invention.

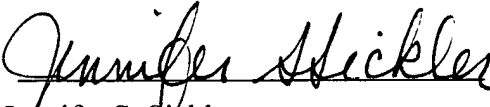
Conclusion

In view of the foregoing remarks, Applicant respectfully submits that the application is now in condition for allowance, and respectfully requests issuance of a Notice of Allowance directed towards claims 1-22.

Should any fee be due in connection with the filing of this document the Commissioner for Patents is hereby authorized to deduct said fee from Deposit Account No. 07-1053.

Respectfully submitted,

Date: 3/2/05


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ONBOARD CAPTURE DESIGN WITH LIDAR

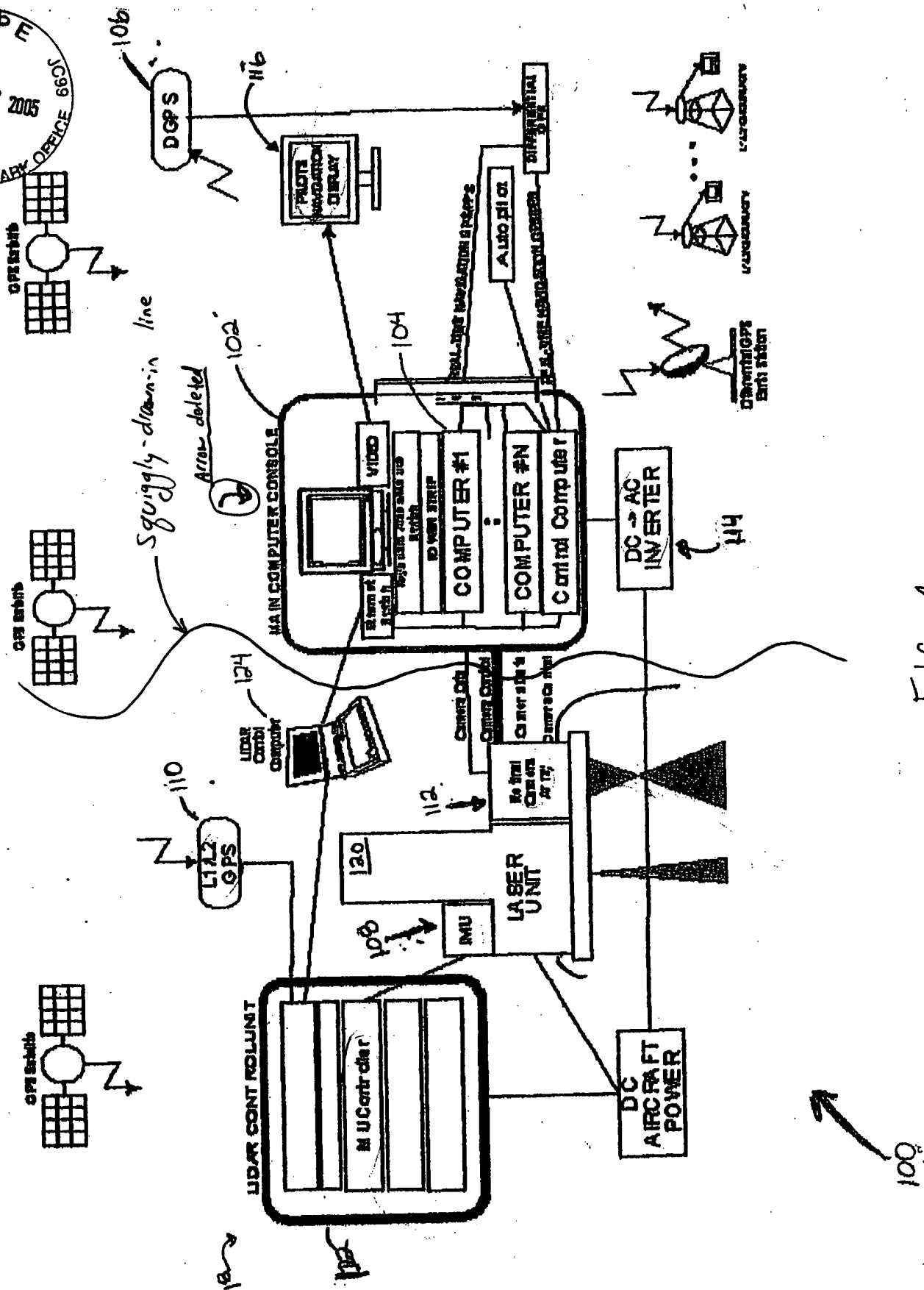


FIG. 1

ONBOARD CAPTURE DESIGN WITH ORTHOSTEREO
 RETINAL CAMERA ARRAY (ORCA)

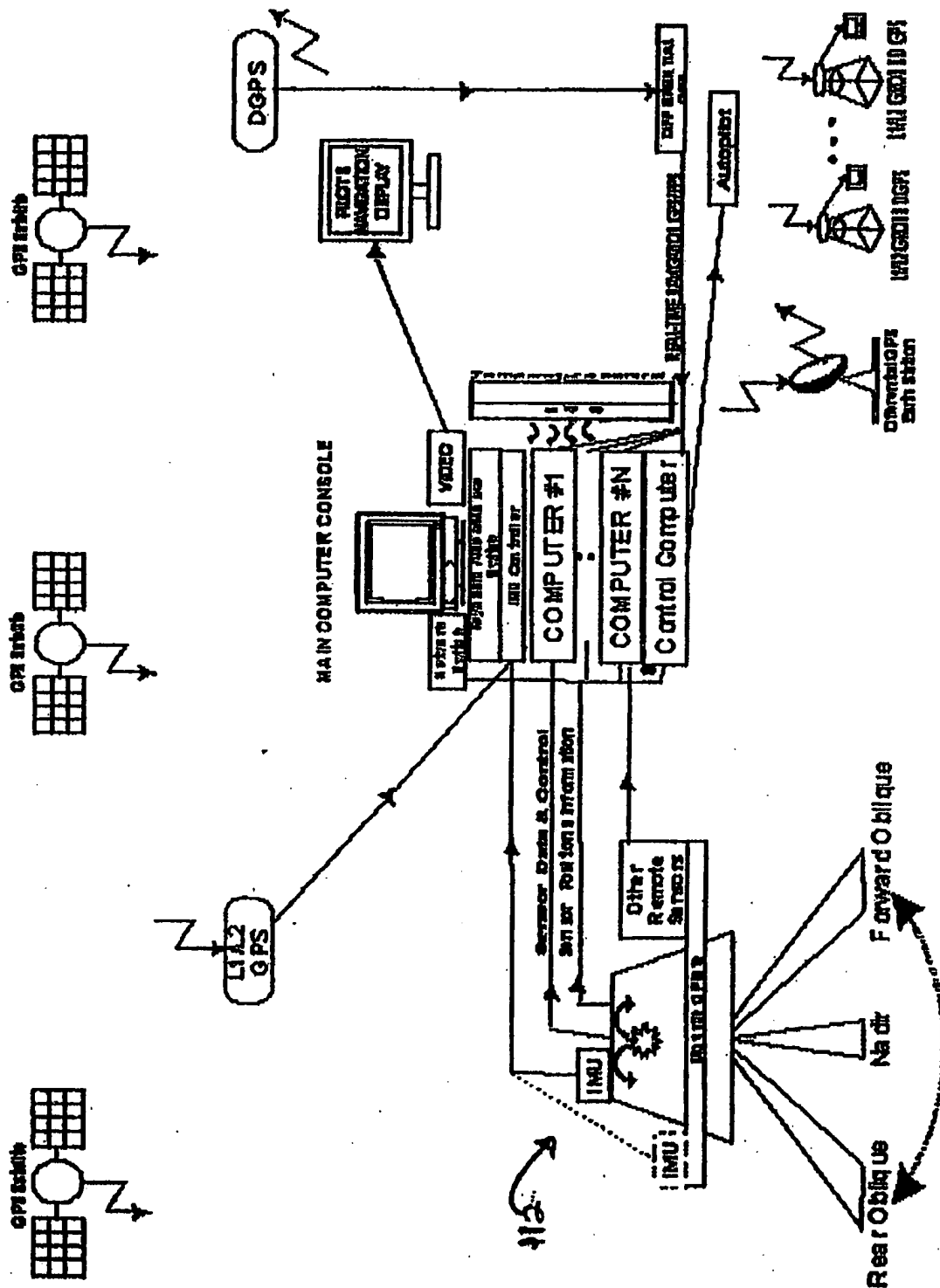


FIG. 2

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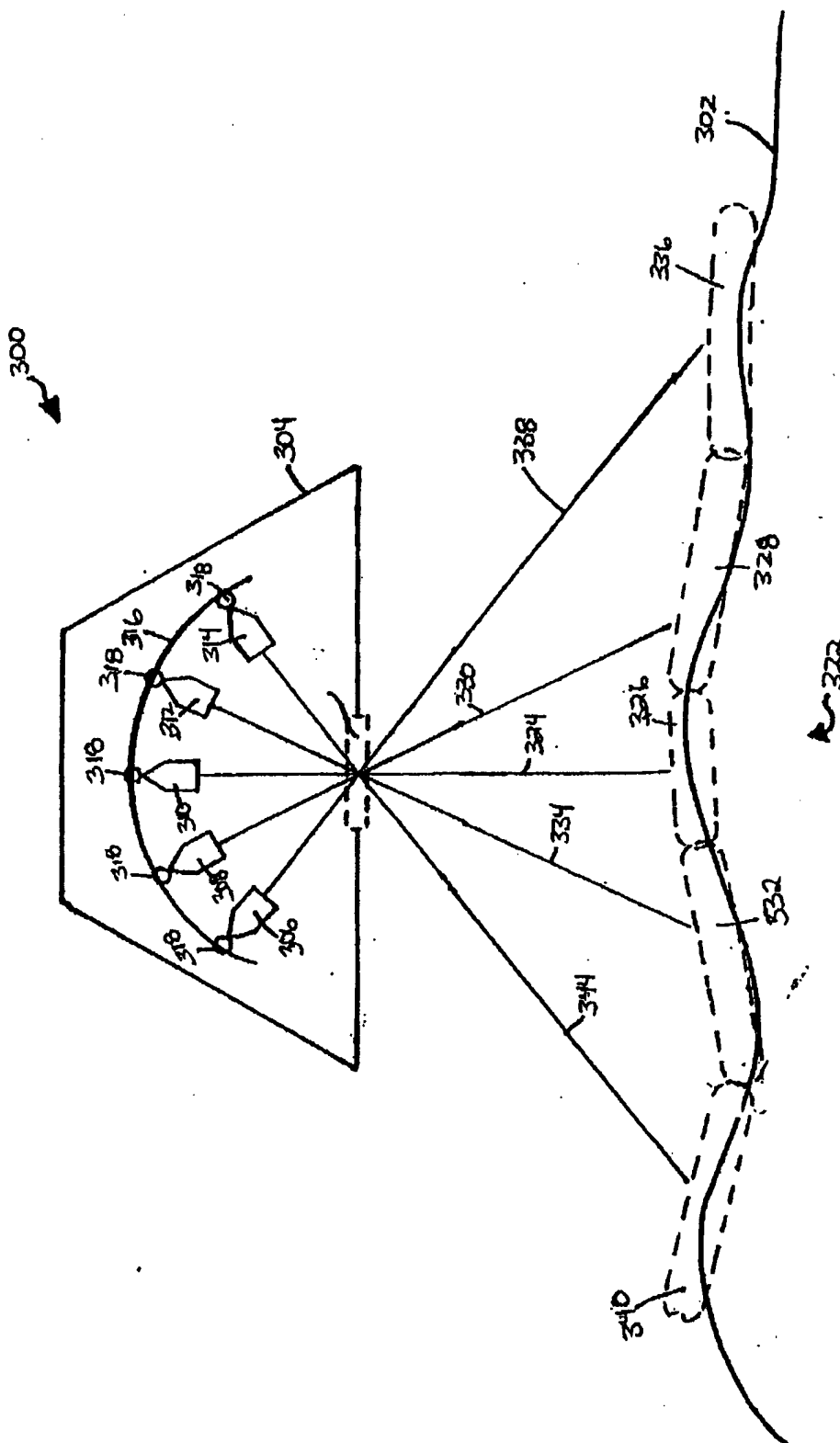


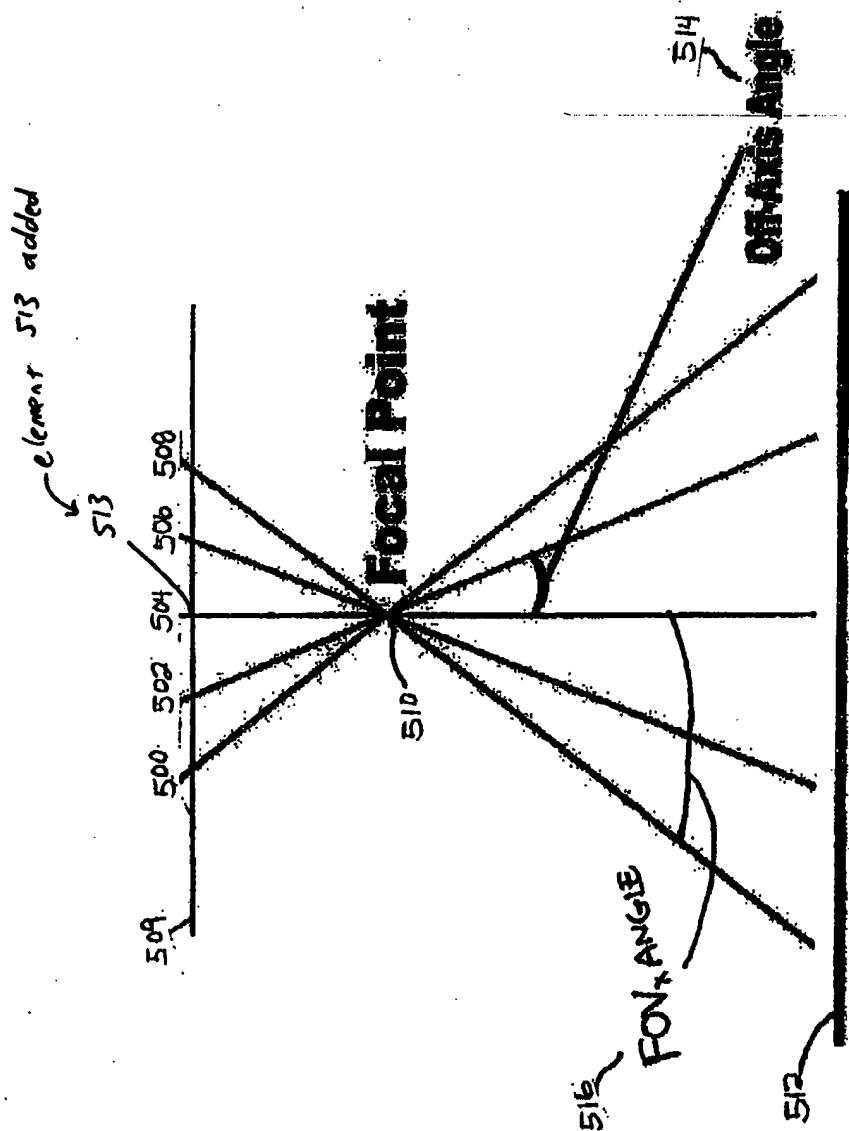
FIG. 3

Far Left Image 340	Near Left Image 332	NADIR IMAGE ● 400 326	Near Right Image 328	Far Right Image 336
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FIG. 4

App. No.: 10/664,737
Reply to Office Action of 12/07/04
Annotated Sheet Showing Changes

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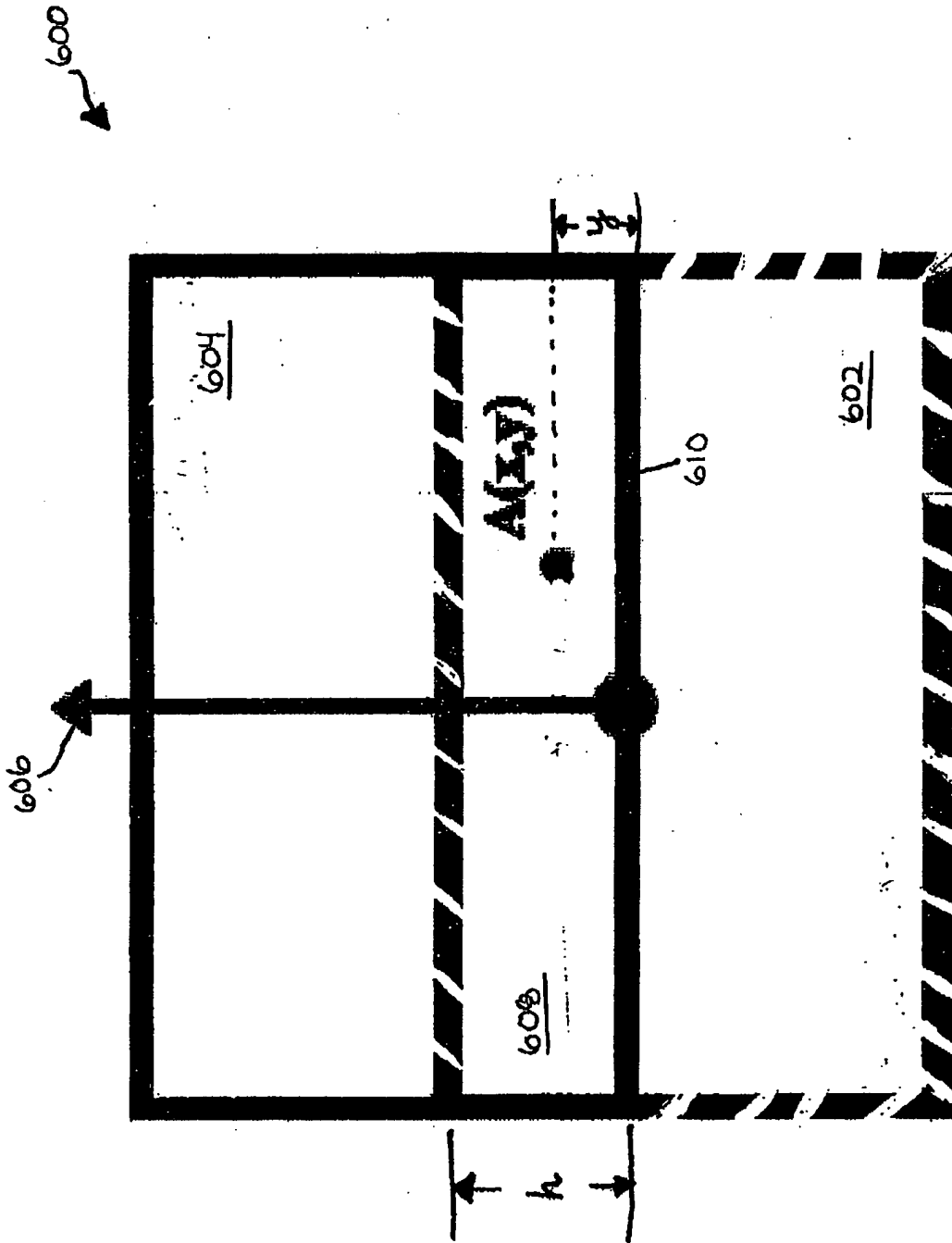
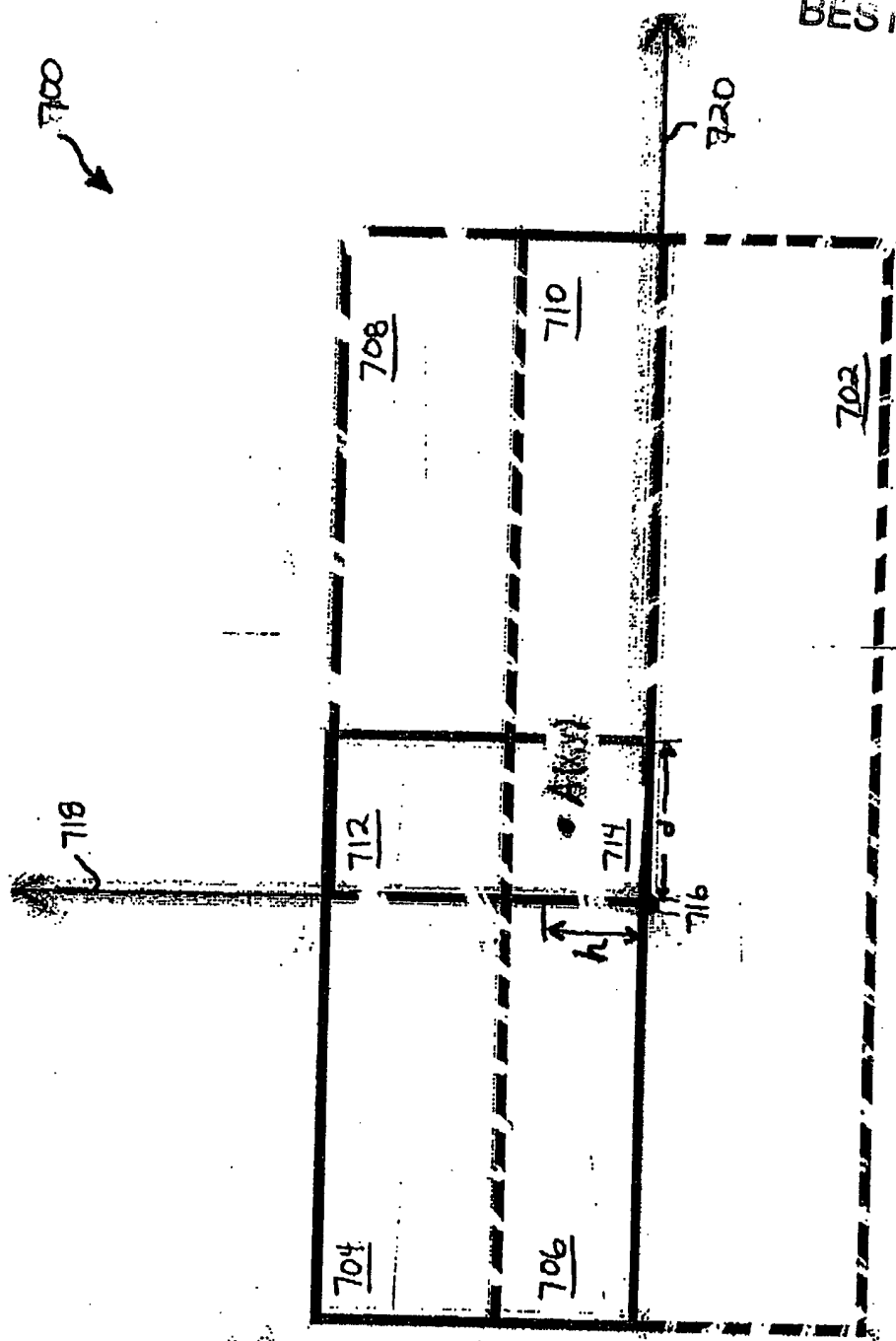


FIG. 6



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FIG. 7

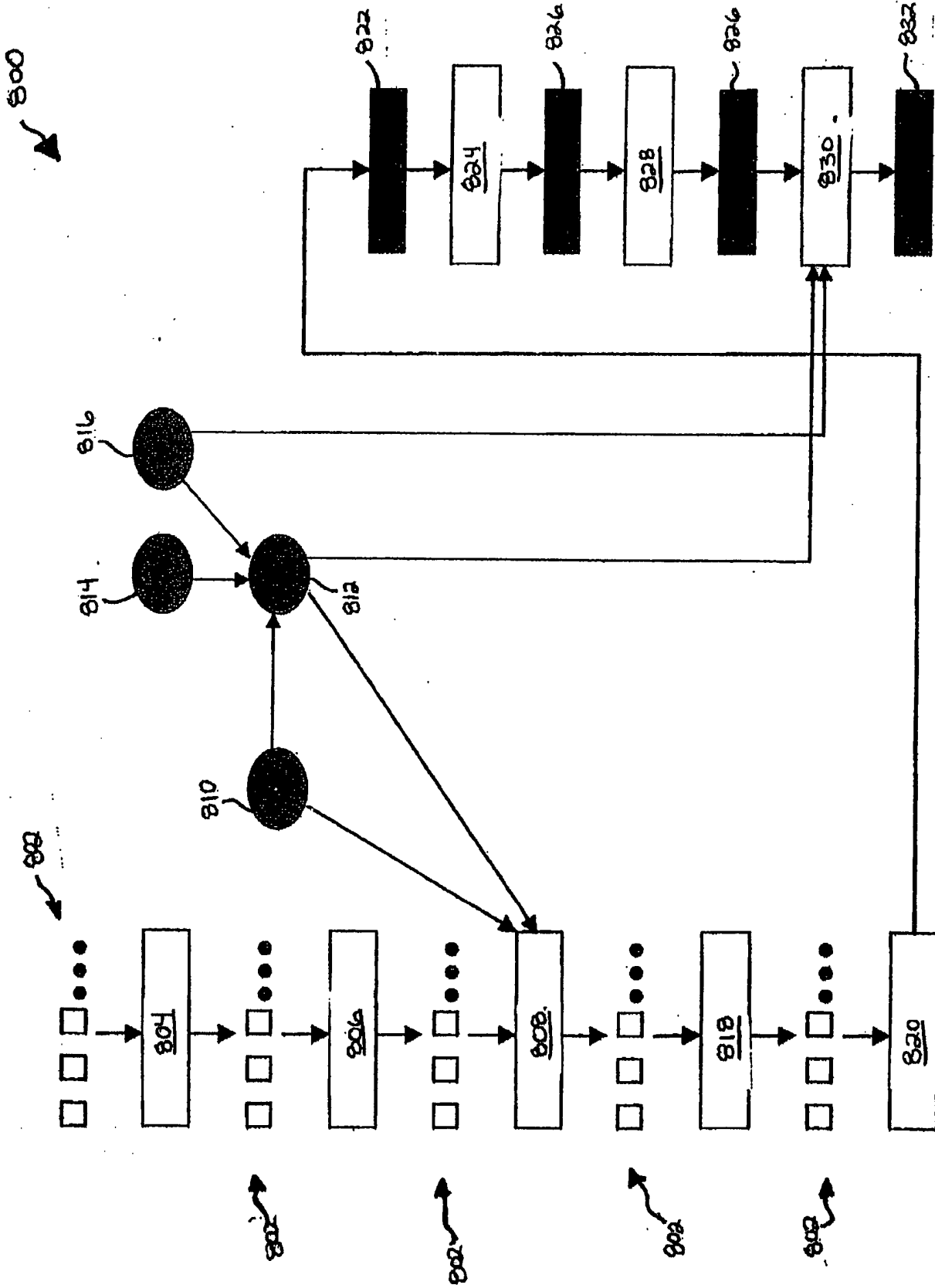


FIG. 8

Figure 9 Photo Pattern Illustration: 1 Flight Mile
Looking down from Aircraft
Five Camera Version Ortho-rectified Data

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Annotated Sheet Showing Changes

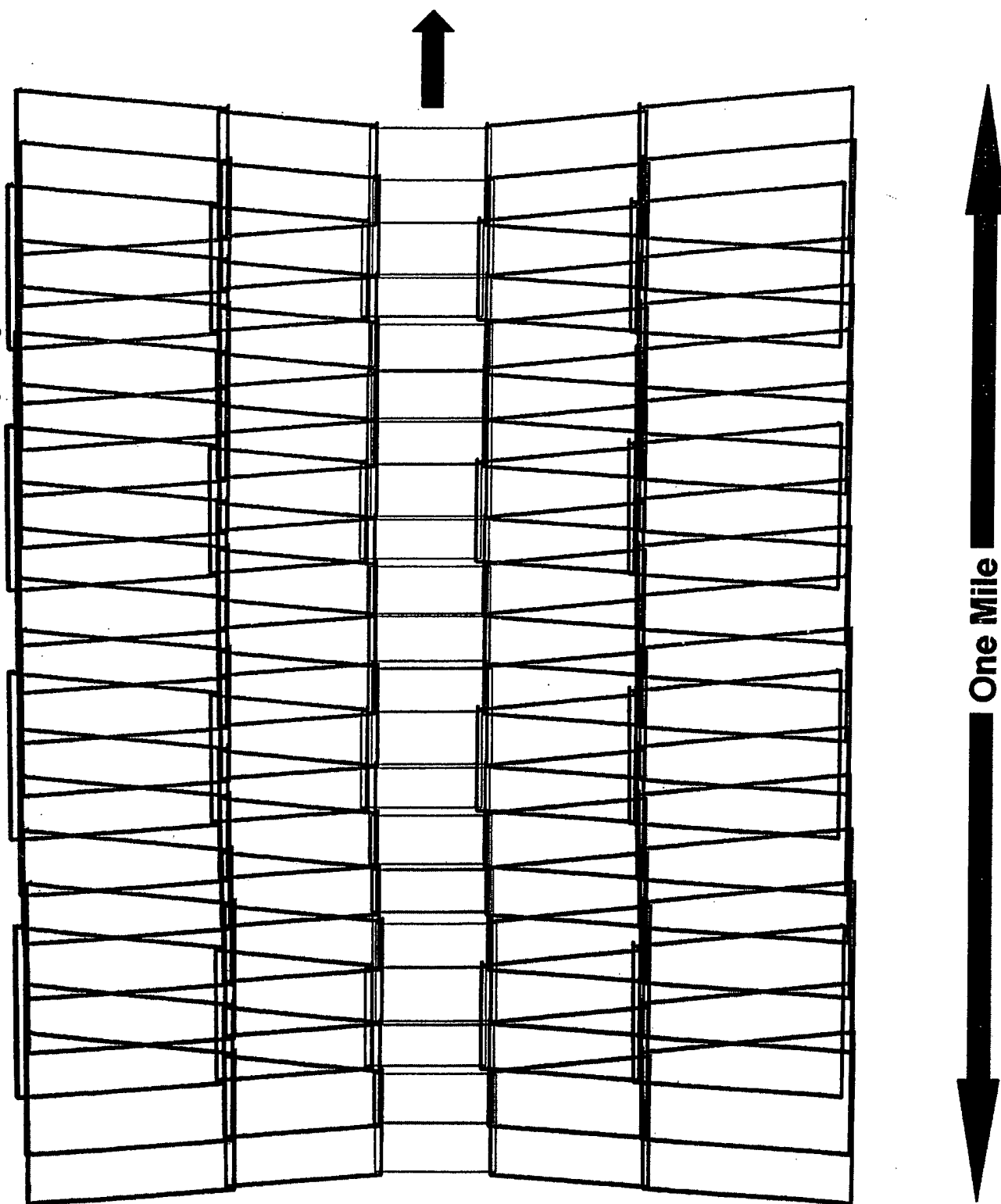


FIGURE 10

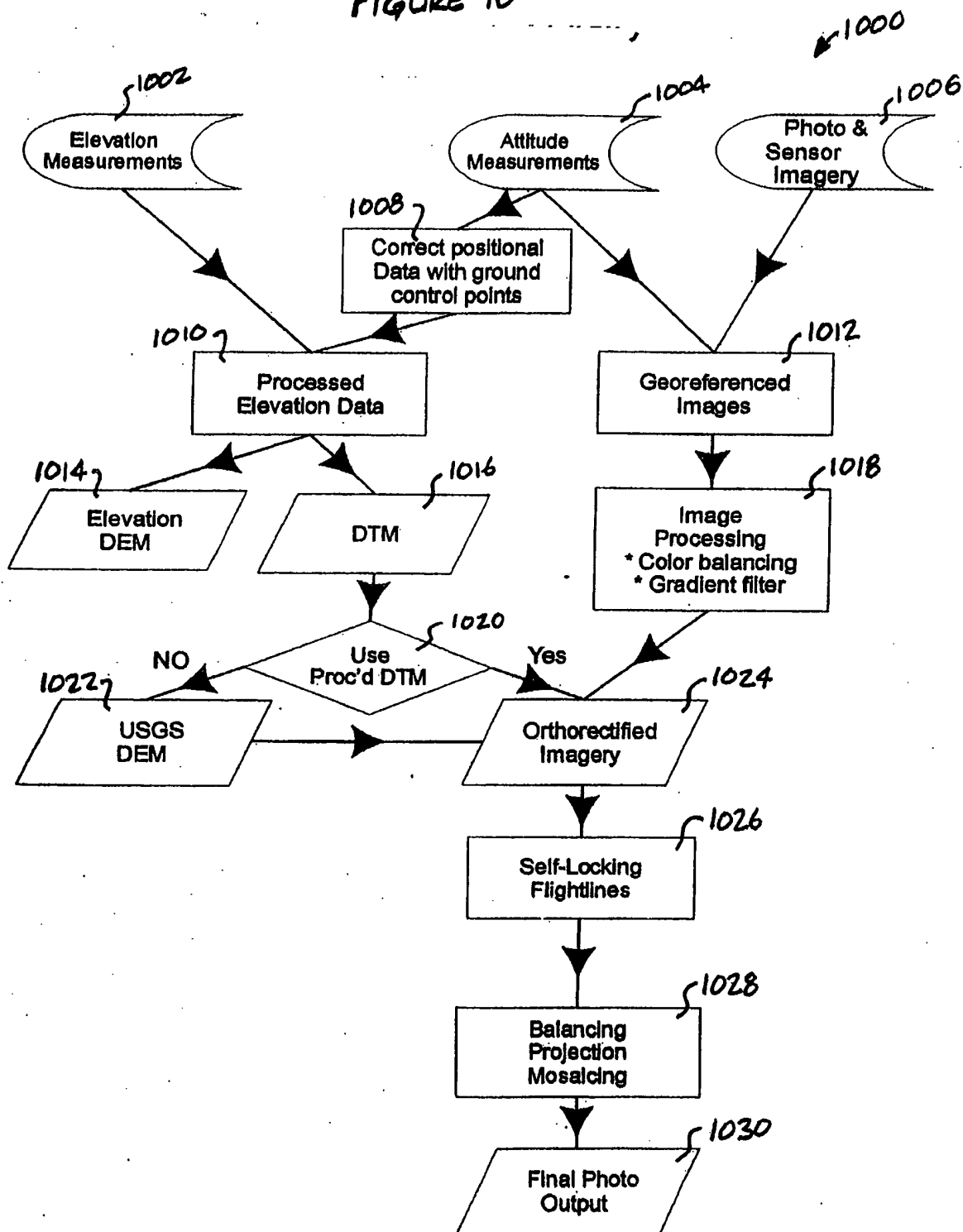


FIGURE 11

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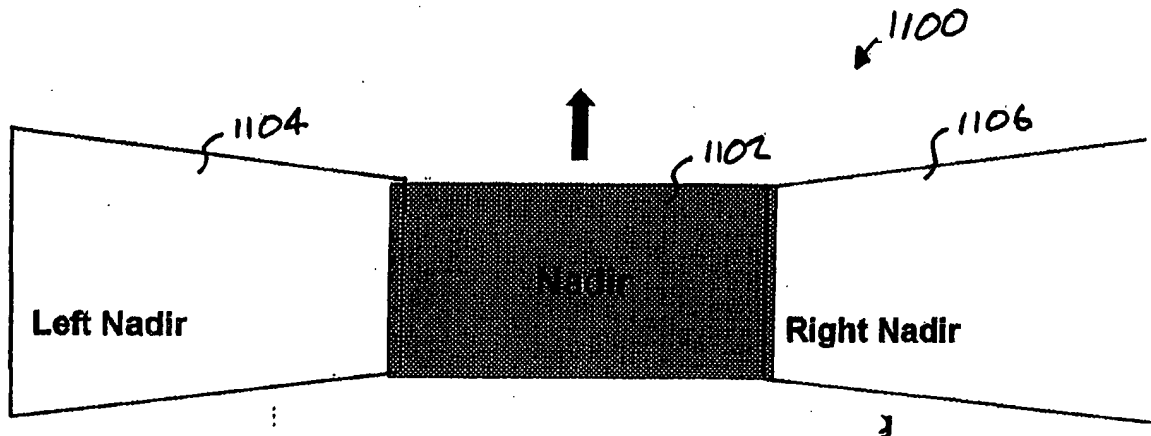
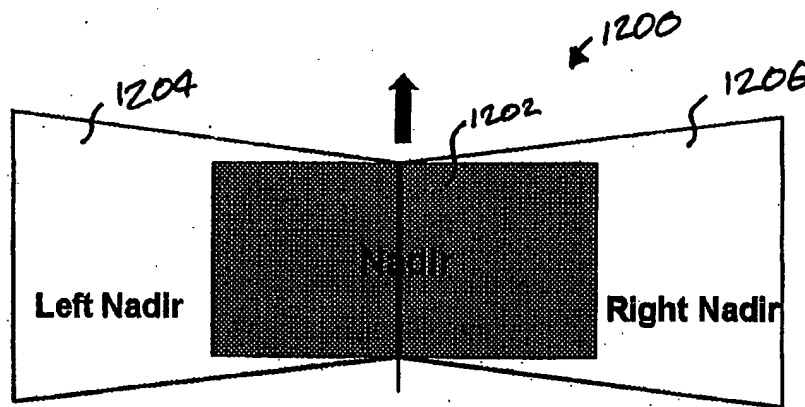


FIGURE 12



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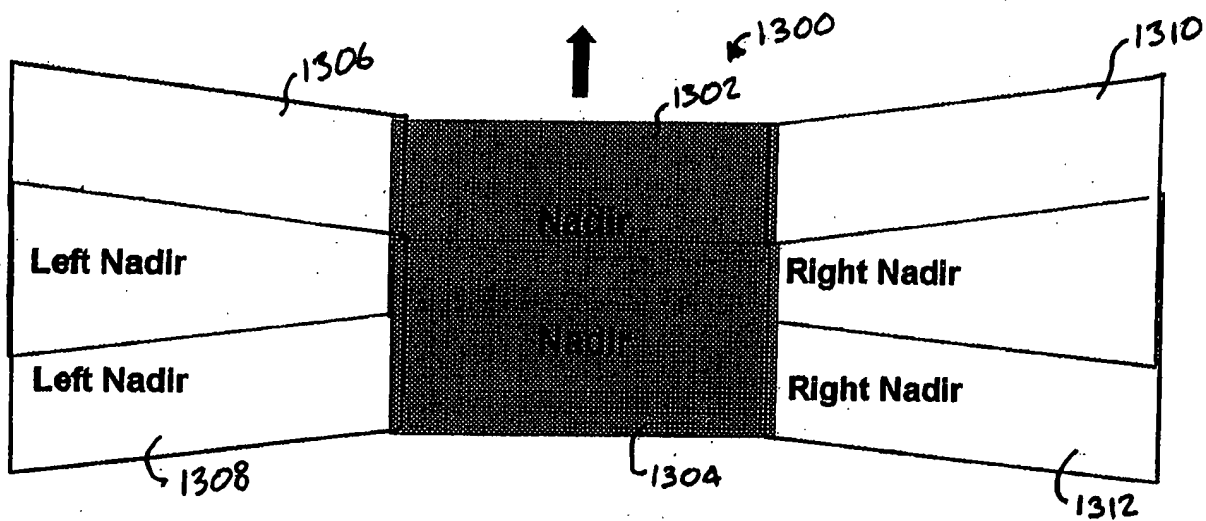


FIGURE 13

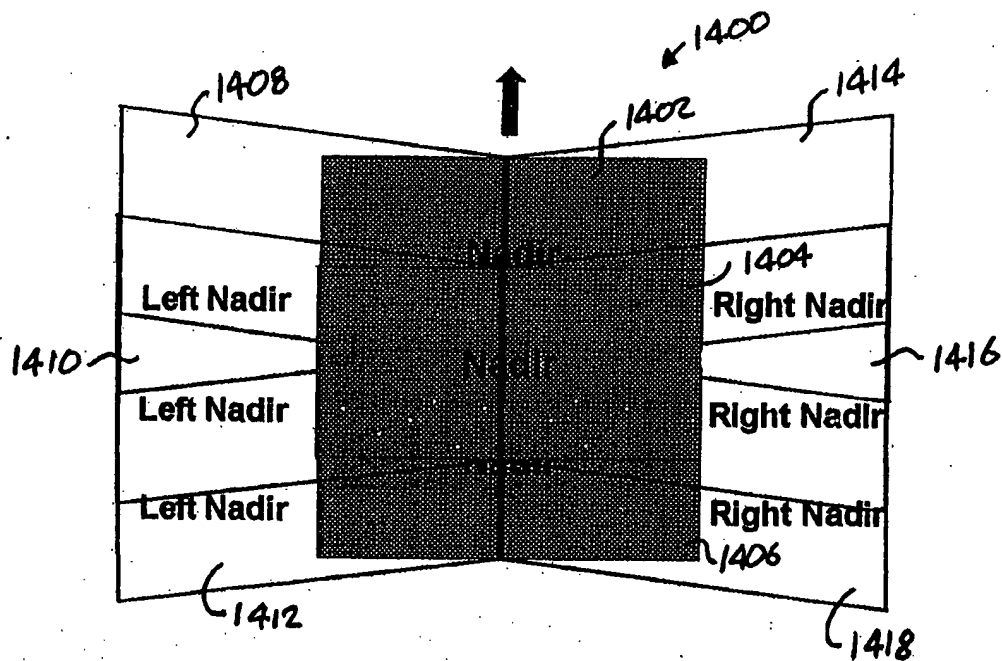
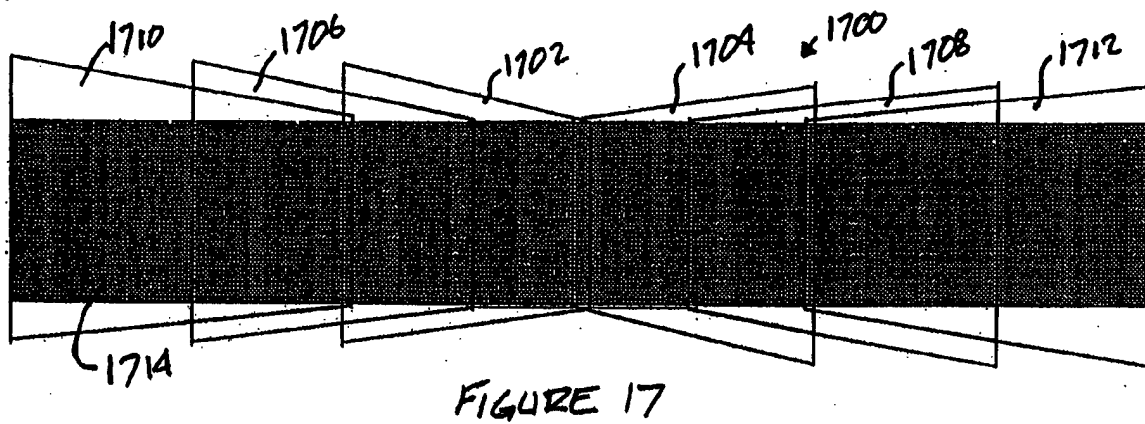
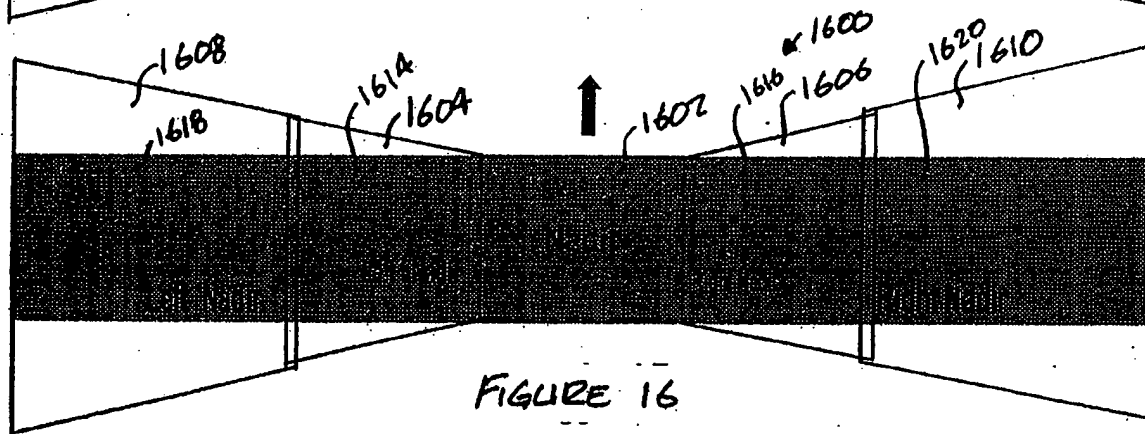
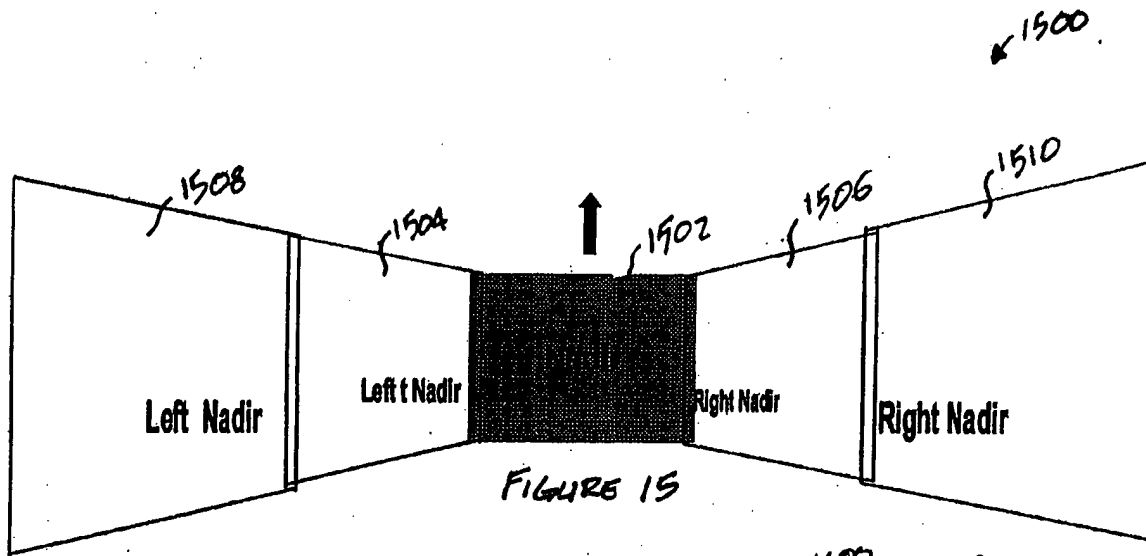


FIGURE 14



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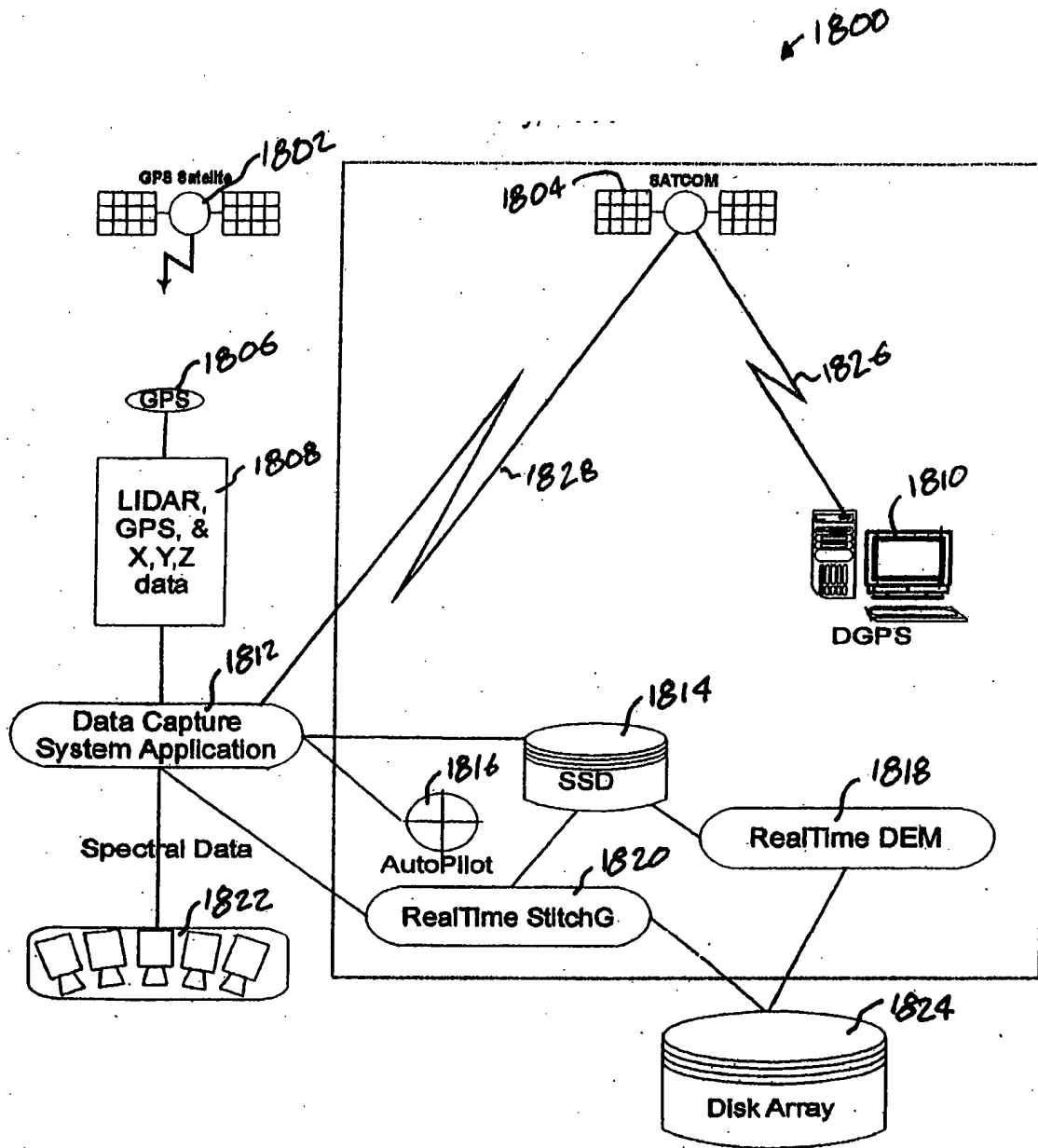


FIGURE 18